



Advanced Technologies for Location, Tracking and Monitoring of Wildlife .

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A discussion of Satellite, Crossband Transponder
and Future Developments

Report Documentation Page

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Small Passerine with VHF radio tag





VHF Biotelemetry – A Summary

- Low cost - <\$200/tag, ~\$500-\$3000 for receiver
- Ranges ~100's m to km's
- Tag Life ~weeks to months
- Tag Weight $\geq 0.5\text{g}$
- Location by triangulation
- Simple signal; differentiate perch/flight, mortality
- Trade Weight, Life, Transmitter Power
- # fixes/day up to observer



Satellite Tag on Peregrine Falcon

- Bird ~ 600g.
- Tag ~20g.
- Backpack mount.
- Duration: 20 days continuous – Duty cycling increases life.
- Cost ~\$3k plus \$1k pa for tracking.





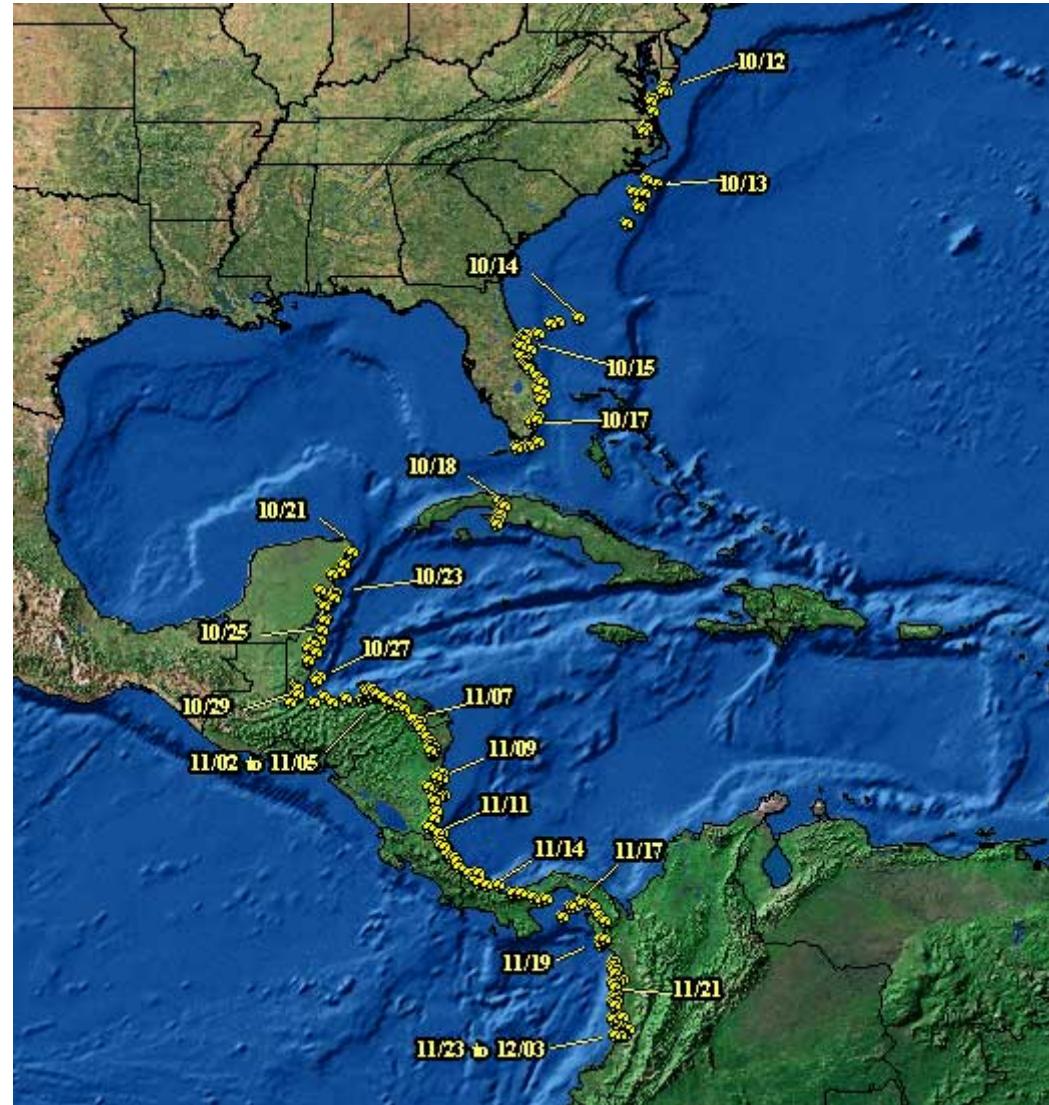
Satellite Tags – A Summary

- **High cost - \$2-4k pa, \$1k pa tracking**
- **Data collection via internet;**
- **Range - Global;**
- **Tag Life ~mo's**
- **Tag Weight \geq 15g - limited to Species $\geq \sim 350$ g**
- **Signal can contain simple telemetry e.g temperature, battery voltage**
- **# fixes/day typically < 20 , not real-time**
- **Best location accuracy 150m rms, often > 500 m**



Argos system – example data

- Peregrine falcon, tagged at Assateague October 2002
- Shows migration route & final destination.



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Solar-powered PTT – 16 grams

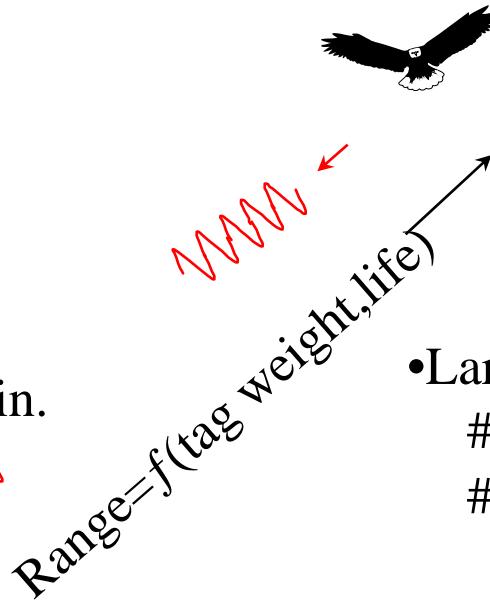
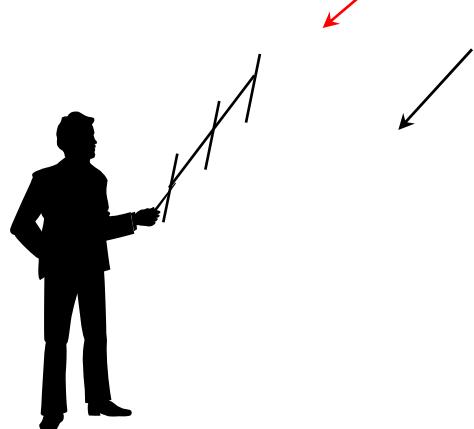




CONVENTIONAL RADIO TRACKING OF BIRDS

Radio 'Tag' Characteristics:

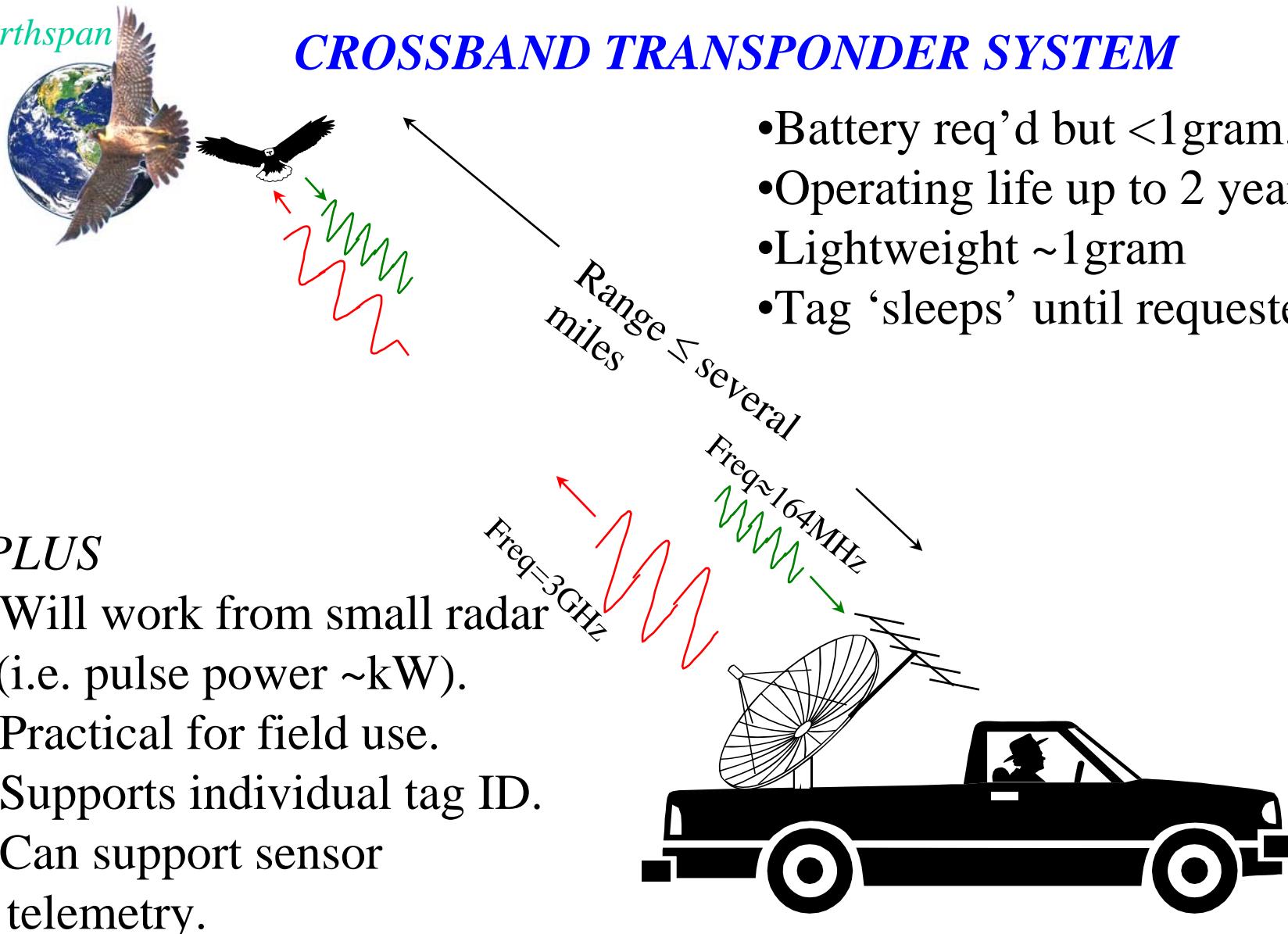
- Battery powered.
- Freq. \approx 164MHz (typical).
- Transmits 10-30mS pulses.
- Pulse rate typically 40-60/min.



- Large birds: (>100g):
#Tags last 3 months-4 years.
#range \leq 10 miles*.
- Small birds (<100g):
#Tags last only a few weeks.
#range \leq 1-2 miles*.
- Therefore long-term tracking of small birds difficult

*Tracking from the ground

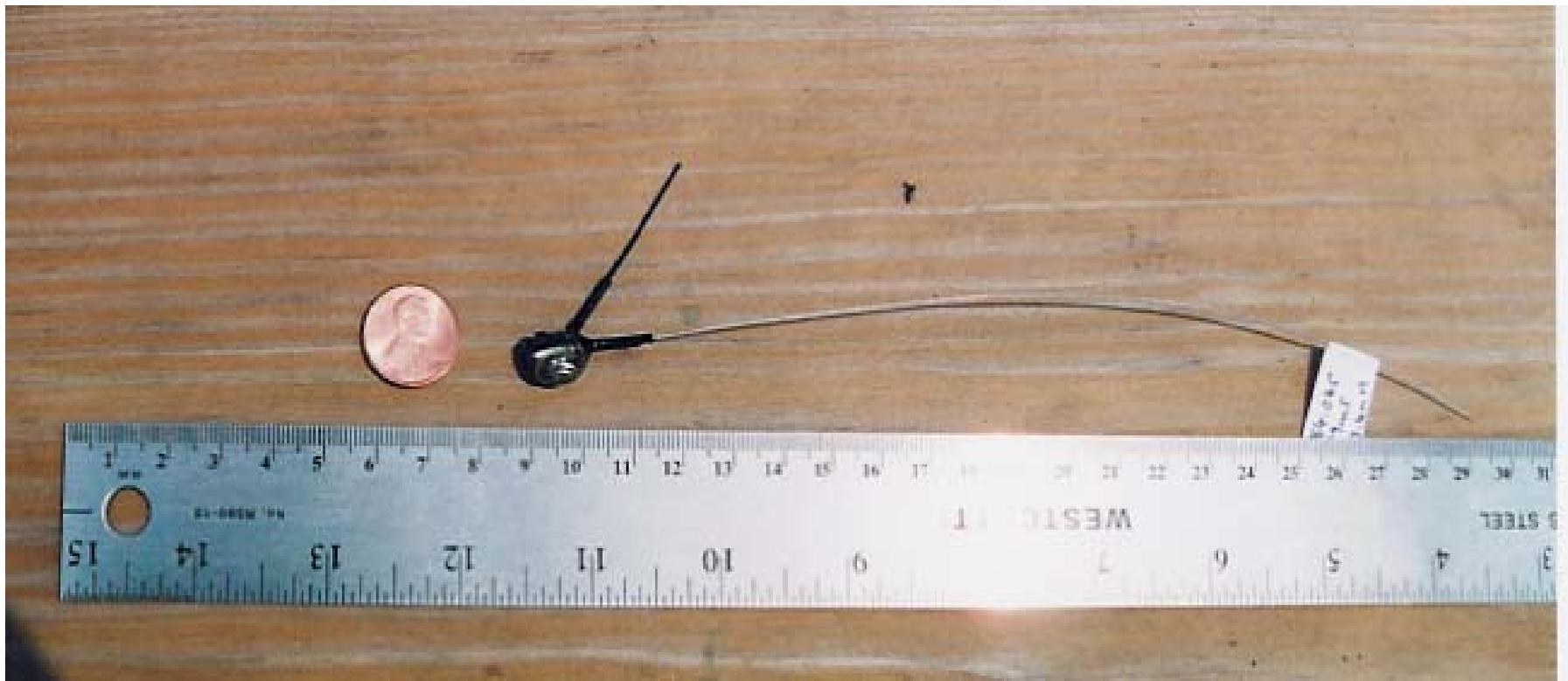
CROSSBAND TRANSPONDER SYSTEM





Crossband Transponder Tag

1.2 grams; 2+ yr duration @ 100 interrogations/day





B.h Cowbird with CBT Tag



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Interrogator & Receiver System





Conclusions – land-based CBT System

- Range in v. flat open landscape, with radar at ground level, <400m
- Range up to 1000m for tags 2m from ground.
- Raising height of radar above landscape by several metres or more yields major range improvement.
- No good for arboreal landscapes – trees block radar
- For tags at or below treetop height, good only for open landscapes, or sea



Airborne Operation

Advantages

- **Detection of tags on ground with no loss of range**
- **Triggering of tagged birds in vegetation**
- **Stronger VHF reply signal**

- **Estimated trigger range: >1 mile for aircraft at 2000 feet***

*** Using Small (19"x9"x5") lightweight (20lbs) battery-operated interrogator - in development.**



Future potential developments

Crossband Transponder System

- o **Coded response ID, for faster searches**
- o **Two-way communications between tags and Radar**
- o **Range measurement**
- **Active Transponders using existing Radars.**
- **Harmonic Radar**

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END



Some species studied using satellite tags

- **White-faced Ibis in NV** – found source of DDT contamination.
- **Swainsons Hawk** – found cause of mass mortality in Argentina.
- **Peregrine Falcon** – migration routes and destinations.
- **Albatross** – feeding flights of several 1000 miles.
high mortality from long-line fishing.
- **Caribou** – migration routes
- **Brown Bears** – Home range and juvenile dispersal.



Argos system – the Tags

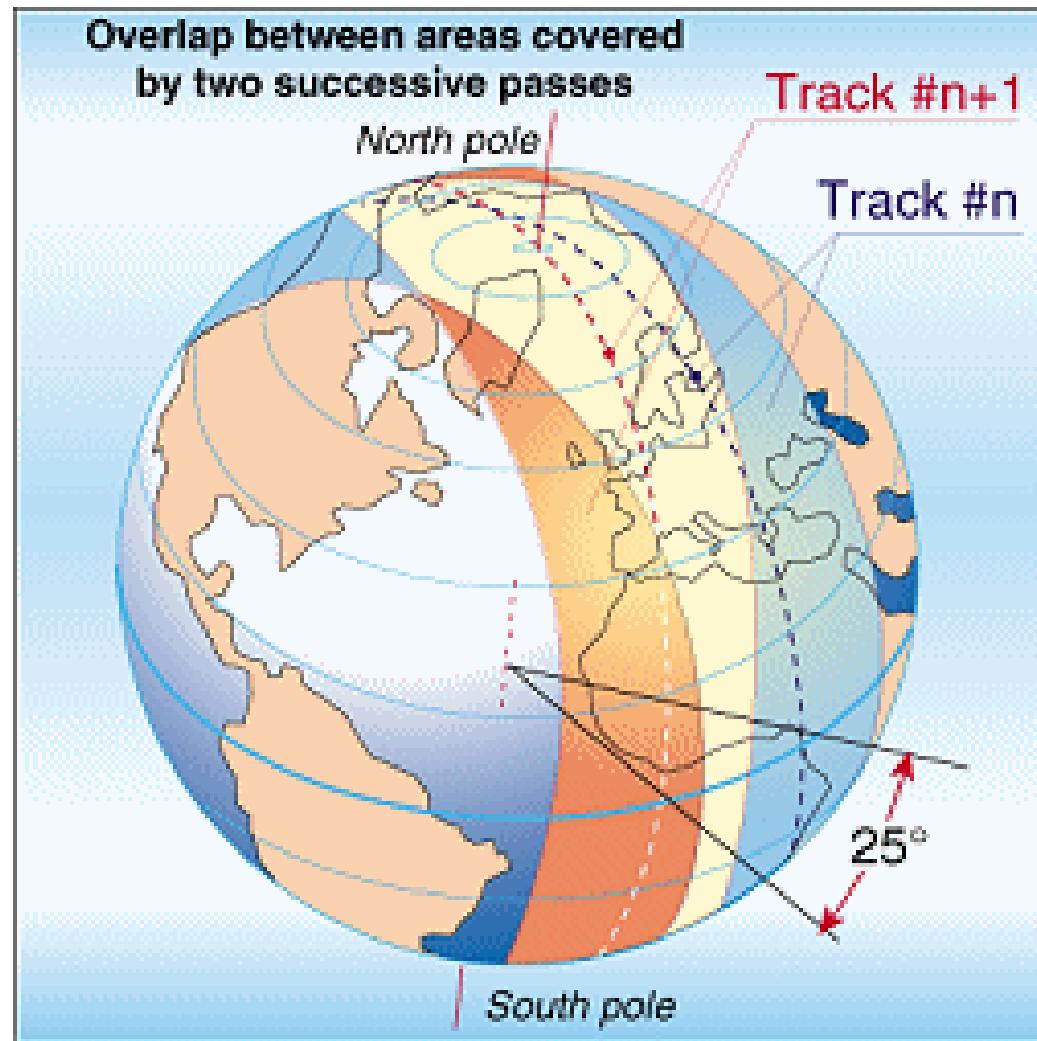
- Transmit a ~360ms BPSK data modulated pulse every minute, @401.65MHz, $\geq 160\text{mW}$.
- Uplink only (downlink in future).
- Tags are distinguished by ID code.
- Tags weights from 16g
- Powered by battery, or solar & battery/capacitor
- Principle tradeoff is duration = $f(\# \text{ transmissions/day})$.
- Ranges of species studied.

Birds, from 400g up.

Animals: Mammals, as small as a fox.
 Reptiles; turtles.

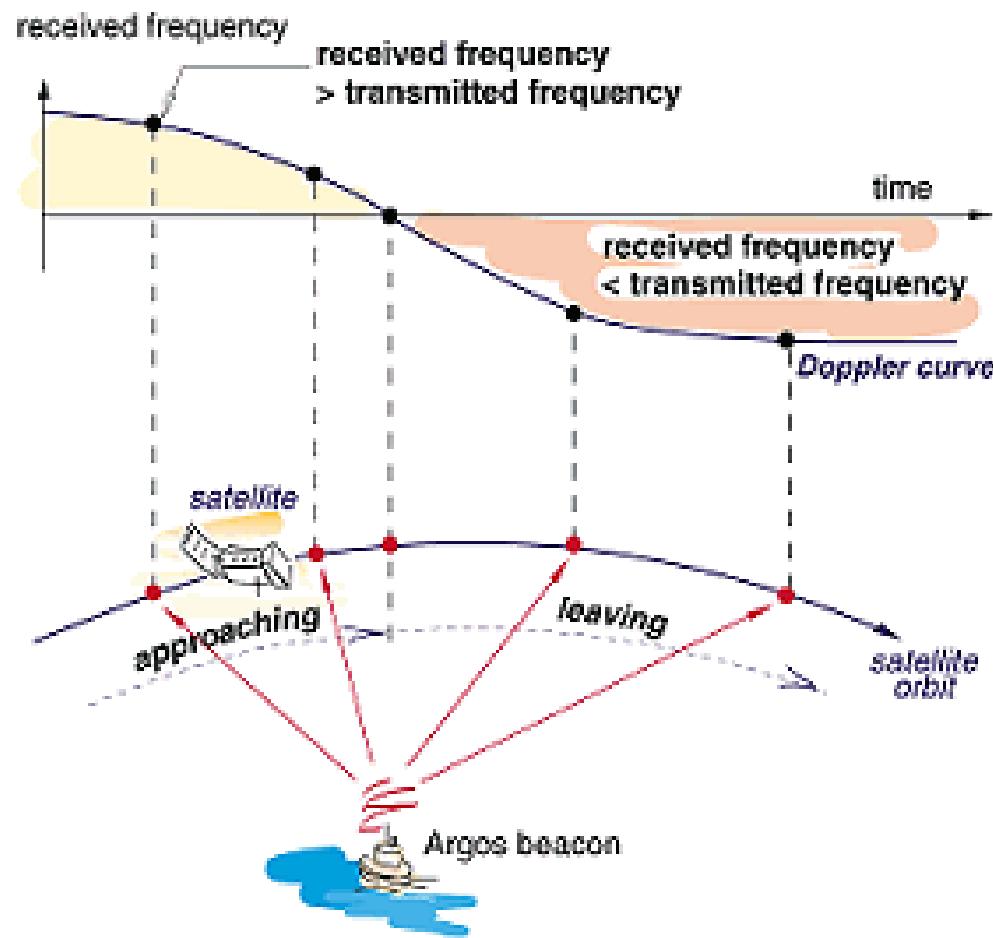


How Argos works (2)



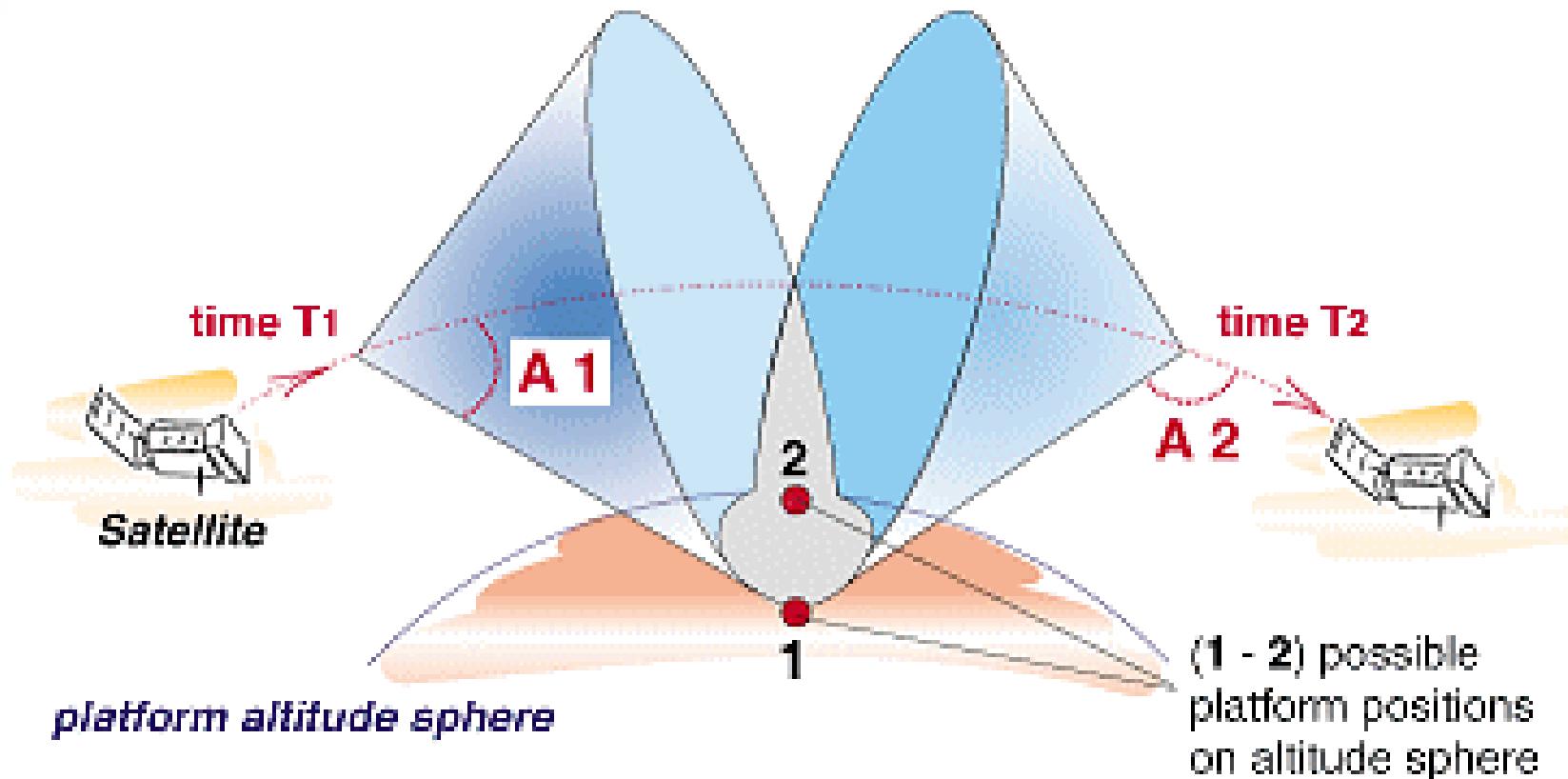


How Argos works (3)





How Argos works (4)





Argos system & GPS

- Can incorporate GPS receiver & telemeter GPS coordinates in tag message.
- Power/Weight penalty due to signal processing required.
- Upcoming technology will solve problem.

